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Abstract

Network control (or network management) functions are essential for efficient and reliable operation of a network. Some control functions are currently included as part of the OSI (Open Systems Interconnection) model. For local area networks it is widely recognized that there is a need for additional control functions, including fault isolation functions, monitoring functions, and configuration functions. These functions can be implemented in either a central or a distributed manner. The FDDI (Fiber Distributed Data Interface) Medium Access Control and Station Management protocols provide an example of a distributed implementation.

Network Reliability

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Outline

- Meaning of network reliability
- Current approach to problem
- Additional issues to address
- Implementation alternatives
- Issues for study

State of local area network technology

- Past –
Mechanics of communication emphasized
- Present –
Need for network control recognized
- Space Station –
Requires high degree of reliability

Meaning of Reliability

- Wide area networks —

Degree of connectivity, i.e., availability of alternate routing

- Local area networks —

Ensuring that a single error will not cause failure of the entire network

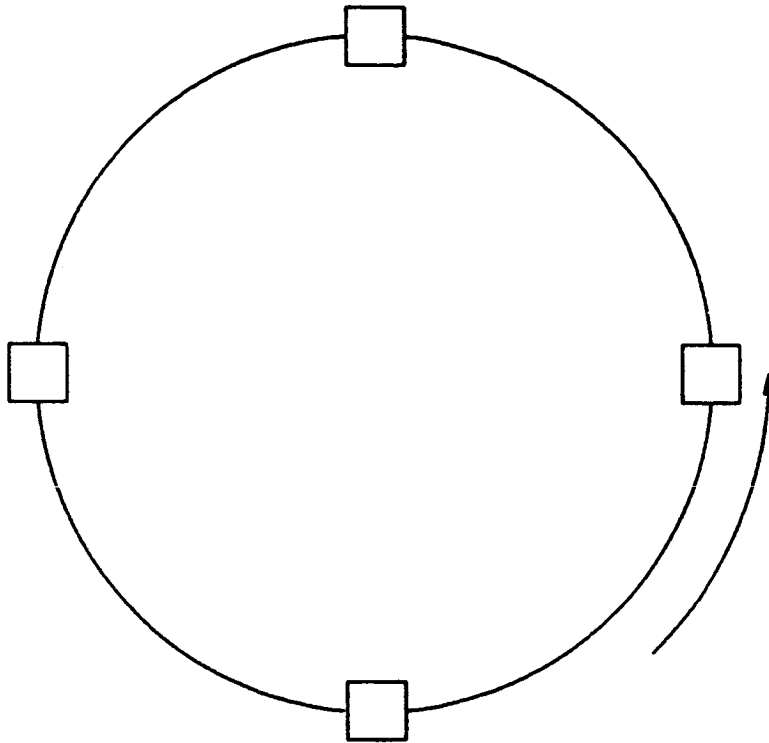
Providing for recovery from errors without significant degradation of performance

General Reliability

Concerns for LANs

- Cable vulnerability
- Jabbering transmitter
- Failure isolation
- Bit synchronization
- Protocol-related problems

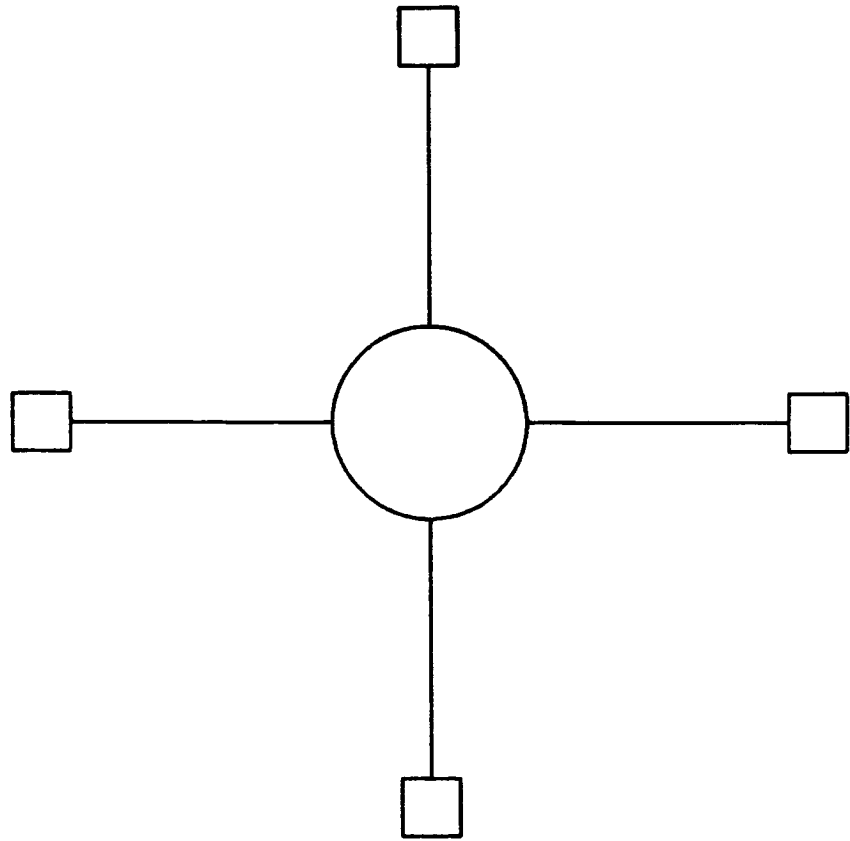
Token Ring



Reliability concerns

- Break in physical path
- Token—related problems
 - Lost token
 - Duplicate tokens
 - Token recovery

Star Topology



Reliability concerns

- Vulnerability of star node
- Complexity of star node
- Coordinating time-slots
- Station insertion or removal

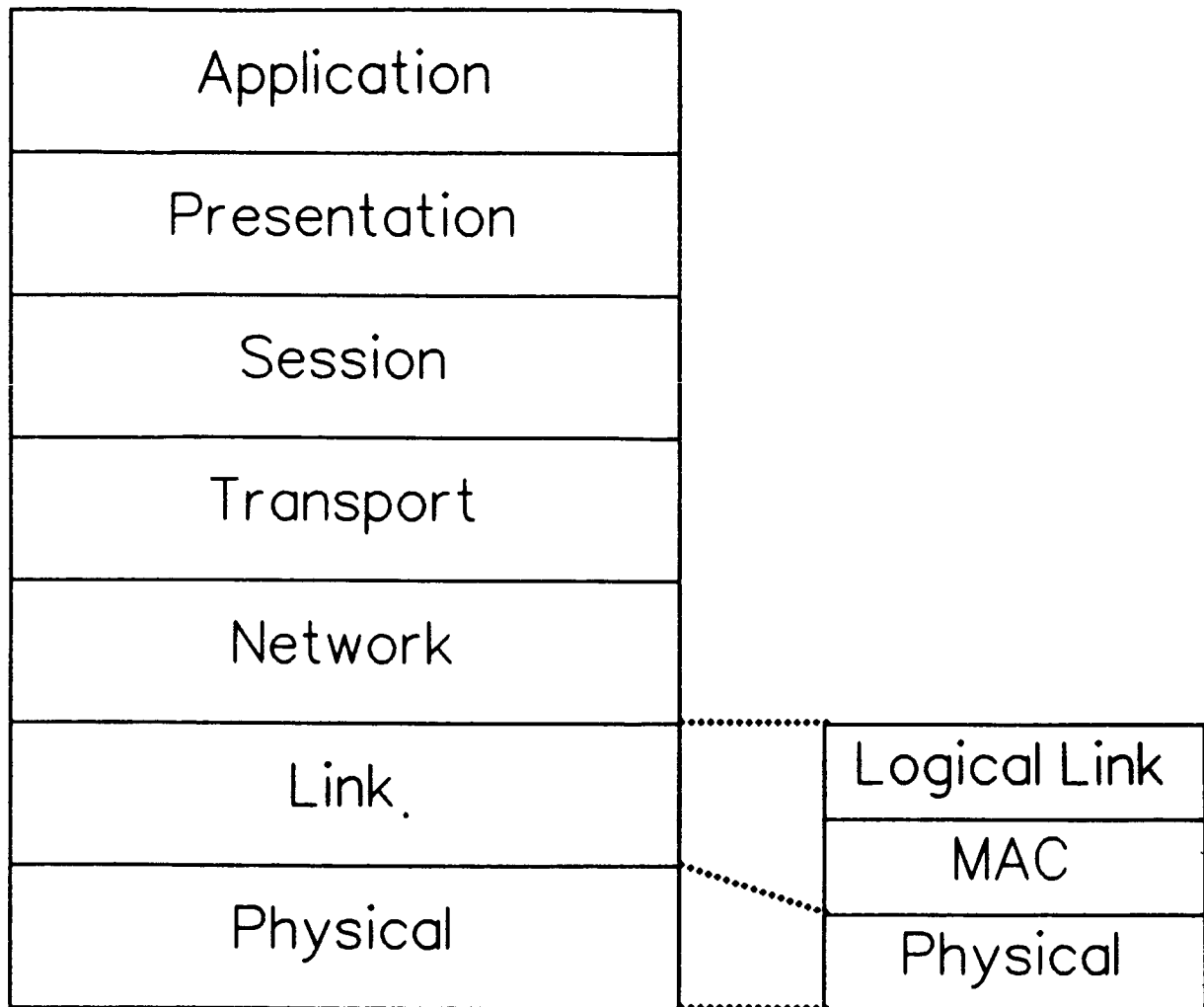
Layers of OSI Model

Application
Presentation
Session
Transport
Network
Link
Physical

OSI Control Functions

- Link Layer
 - Flow control
 - Error control
 - Acknowledgement
- Network Layer
 - Virtual circuit service
 - Datagram service
 - Congestion control
- Transport Layer
 - Buffer control
 - Connection management
 - End-to-end error recovery and flow control
- Application Layer
 - Network management

Layers of OSI Model for Local Area Networks



Local Area Network Control

- Fault isolation
 - Monitor network to detect faults
 - Isolate fault to single component
 - Fault correction
- Monitoring functions
 - Performance measurement
 - Performance analysis
 - Artificial traffic generation
- Configuration functions
 - Directory management
 - Set station parameters
 - Station insertion and removal
 - Station reset

Statistics to gather

- number of packets
- number of packets by source
- number of packets by destination
- number of data packets
- number of control packets
- packet size
- packet delay
- number of retransmissions
- number of collisions
- number of packets received in error

Data analysis

- Distribution of traffic
- Excessive collisions?
- Excessive retransmissions?
- Excessive packet delay?
- Success of station in transmitting packets
- Maximum capacity of channel
- Effect of traffic load on performance

Artificial traffic generation

- Test network in laboratory
- Indicate existence of potential problems
- Indicate efficiency of system
- Plan for future growth

Implementation alternatives

Central

- Network Control Center
- NBS "measurement center"

Distributed

- Separate network control layer
- Implementing control functions in each layer

FDDI Network Control

Application	U M T
Presentation	
Session	
Transport	
Network	
Logical Link	S M T
MAC	
Physical	

SMT = Station Management

UMT = Upper Management

FDDI Implementation of control functions

- Fault isolation functions
 - Timers
 - Claim token recovery process
 - Beacon frame
- Configuration functions
 - Optical station bypass
 - Redundant channel
- Station Management functions
 - Station reset
 - Insertion of station
 - Timer alignment

- Monitoring functions
 - Status bits
 - Station flags
 - Error detected
 - Address recognized
 - Frame copied
 - Station counters
 - Frames received
 - Timer expirations
 - Interface to Station Management

Open Issues

- Identify proper control functions to assign to upper layers of the OSI model
- Determine effect on network performance and network reliability of
 - Buffer management
 - Acknowledgement schemes
 - Retransmission schemes
 - Multi-layer protocol structure
- Determine how to automate control functions

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